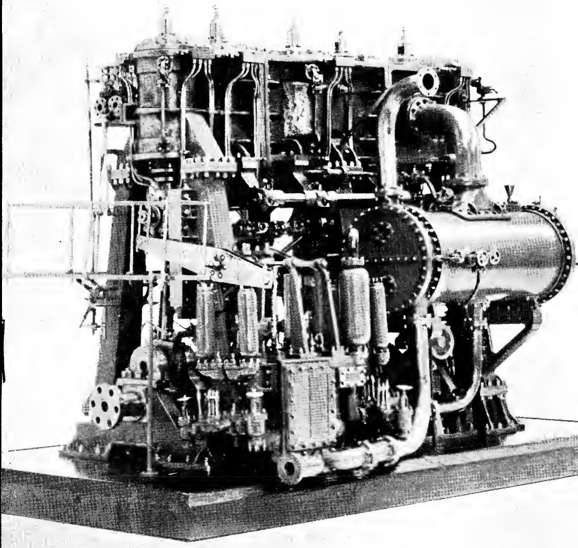
THE MODEL ENGINEER



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The MODEL ENGINEER

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S M O K E R I N G S

Our Cover Picture

● THE PHOTOGRAPH used for our cover illustration this week shows a model by Mr. John A. Kay, of Greenford, Middlesex. This picture gained second prize in the recent "M.E." Photographic Competition. Not only is it an excellent photograph from the technical point of view, but it also represents a model the construction of which demanded a very high standard of ability and patience. By a coincidence, this model was also entered in the competition section of THE MODEL ENGINEER Exhibition. It is a working model triple expansion marine engine, 13 in. long, 10 in. wide and 12 in. high, built to a scale of $\frac{5}{8}$ in. to the foot. The prototype was built by Messrs. Cammell Laird & Co. for installation in single-screw vessels.—P.D.

Carrying the Torch

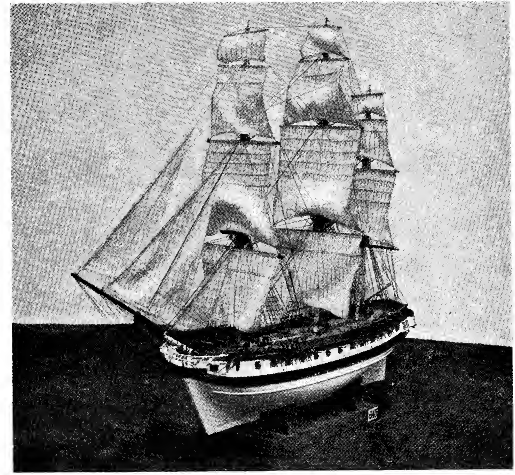
● IN THE exuberance of greeting old friends and meeting new ones at the Exhibition, I found one cause for regret, namely, that our late chief, "P.M.," was no longer with us to share in our enthusiasm. We missed his smile and genial greeting, his word of approbation to the competitor, and encouragement to the beginner. How he would have revelled in the workmanship of the models, the standard of which was higher than ever this year. But the live flame of model engineering, which has burned brightly for so many years despite storms and adverse weather, will continue to burn as brightly as ever while there are enthusiasts to carry on the torch. I feel that no better memorial to the memory of "P.M." could be devised than the annual display of the models he loved, and the concourse of the model engineers to whom his life was devoted.—E.T.W.

The Eve of the Exhibition

● IN THE theatrical world they have a well-known saying, "It'll be all right on the night!" The casual observer, who sees the hectic preparations and rehearsals, is often astounded by the way that an apparently hopeless muddle straightens itself out just—but only just—in time for the opening performance. Similarly, there are many people, seeing THE MODEL ENGINEER Exhibition stands on the eve of the show, who find it almost impossible to believe that anything will be ready by the scheduled time. Stand fitters rushing hither and thither with planks, scaffolding and paint, electricians dangling festoons of cables, and stewards arranging models—all combine to create an impression of profound chaos. But it is all a well-ordered confusion, everyone knows his job, and in due course, the Exhibition springs into being like a gallant ship with sails

set to meet the breeze—" All ship-shape and Bristol fashion." Even to those of us who have been privileged to witness the evolution of the Exhibition year by year, this is still a source of wonder. How is it done ?—Not by mirrors or sleight of hand !—It is just another example of the team work which is possible among enthusiasts working for a common cause.—E.T.W.

he went to Stockholm where he became designer of ships for the Swedish navy. His book, which consists of a series of beautiful plates of designs of various types of ships, is very scarce, and is greatly sought after by ship modelmakers. Another very fine model was that of a " Groninger tjalk " from Utrecht ; this is built of pine or fir and overlaid with pearwood. The quality of the



Ship Models from Abroad

● AMONGST THE most interesting features of the recent MODEL ENGINEER Exhibition, was the selection of models from abroad. These included a number of very fine ship models, one of the most attractive being the model shown in our illustration. This is a model of the frigate " af Chapman," of 1803. The prototype was presumably named in honour of the famous designer, F. H. Chapman, whose well-known book *Architectura Navalis Mercaturia*, published in Stockholm, in 1768, is such a mine of information for the maker of models of that period. Chapman was an Englishman and was employed as a shipwright at Deptford. The story goes that, feeling dissatisfied and desiring more scope for his talents,

work and the finish is exquisite. Spain sent three ship models, all of great interest, and to which reference has already been made in our pages. From Canada we had a built-up model of the 36-gun U.S. frigate, " Raleigh," which was made by J. M. Rogers, of Toronto. The lower half of the hull was not planked, and the workmanship of the keel and ribs thus exposed was of a very high quality.

Considering the difficulties of transport and the complications of international communications in these present times, the international section for both ships and models generally, was most encouraging, and we trust that this feature will be extended very considerably in future exhibitions.—E.B.

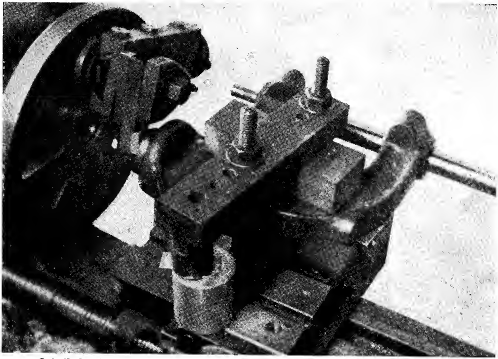
An Awkward Machining Operation

(A Workshop Story with a Moral)

by "Ned"

SOME time ago the writer undertook the machining of a set of castings for a sensitive drilling machine, of a size somewhat larger than the "M.E." drilling machine, and differing from it in many respects. The origin of the design is unknown, though it bears a resemblance to that of a formerly well-known machine by a continental maker with a reputation for precision tools. Many features of the design are, however, open to criticism, not only in presenting quite unnecessary machining problems, but also as affecting the finished accuracy of the machine, and having no compensating advantages in utility or adaptability. The machining difficulties, it may be observed, might not have been so keenly felt if a full manufacturing machine shop had been available, but with only a $3\frac{1}{2}$ in. lathe to work with, some of them assumed formidable proportions.

The most difficult problem of all was the machining of the spindle head, which is the subject of this article. Unlike the "M.E." drilling machine, in which the head is bored to slide on the vertical column, and can be raised or lowered either to provide capacity for work of unusual size, or to adjust belt tension, this machine has a fixed height of head, the column being in the form of a steel tube, seated at the lower end on a machined spigot on the baseplate casting. The head casting has a similar spigot which seats in the top end of the tube, and a long stud passing right through the column, with a sunk nut on the underside of the baseplate, holds the assembly together, with the column in compression.



Spindle-head casting set up on cross-slide for machining spindle bearings and spigot

It will be apparent that any error in the accuracy of the seating faces at either end of the column tube, or on the head and baseplate, will seriously affect the accuracy of the assembly. There are four points at which errors may be introduced, and apart from those in actual machining, the presence of a burr or a speck of swarf may cause inaccuracy on assembly; in any case, the errors will be greatly exaggerated, owing to the small area of the seating surface in relation to the radial distance of the spindle from the column centre. Inaccuracy at the base seating will not affect work carried on or located from the drill table, which is seated on the

column, but it is often desirable to locate from the baseplate when large work is being drilled, and it will be noted that in the " M.E." machine, this is provided for by machined facings on the baseplate casting.

It is presumed that the seating spigot on the spindle-head casting was intended to be machined between centres, as a boss is cast on the upper part of the casting, approximately co-axial with the spigot, which could be marked out and centre-drilled for this operation. But the radial swing was more than could be accommodated in a 3½ in. lathe, and in any case, if it were carried out in this way, the problem still remained of boring the spindle bearings exactly parallel with the seating spigot. In some classes of machining work, it would be sufficient to mark out the locations of the four centres by means of a scribing block on the surface plate, but in view of the possible errors which may occur in working to marked lines or centre-pops, this method was not considered sufficiently accurate for a machine tool.

No doubt the factory method of carrying out this work would be to use an aligning jig, in which the location points would be the spigot and the centred boss; but here again, apart from the work of making the jig, this would call for larger and possibly more elaborate machine tool equipment than was available.

Another Snag

It was therefore decided to bolt the casting to the cross-slide of the lathe, with the spindle and spigot centre-lines exactly horizontal, and in line with the lathe centres. The spigot could then be machined by rotary cutters held in the lathe chuck, and after traversing over for the required radial distance, the spindle bearings could be drilled and bored by a boring bar. But here again, another snag arose, for the casting, as may be seen from the photographs, had absolutely no provision for holding in this way; there were no surfaces parallel with the axis, or broad enough to provide an ample bearing surface when resting on parallel packing strips. One might, possibly, have been able to utilise small " bottle-jacks," of the type which has been described by " Duplex," had they been available in a suitable size, which would need to be unusually small, in view of the restricted height. As things stood, however, it was necessary to resort to measures somewhat reminiscent of the illustrations of the late Mr. Heath Robinson, justifiable only by the fact that they served their purpose quite effectively.

It will be seen that the casting is sandwiched between two solid blocks of hardwood, roughly shaped to bed down to the required points on the casting, exact fitting being left to the compressibility of the material. Two long ⅜-in. tee bolts, anchored in the slots of the cross-slide, in conjunction with a very hefty steel bar, were used to hold the assembly down. As an added precaution against shifting, the extended arm of the casting, which carries the jockey pulley spindle, was supported on a metal packing piece, another packing piece being placed on top of it, so that the extended end of the steel bar could be brought to bear upon it. Some very careful and patient fitting of the packings was necessary before everything was properly lined up and secured, but eventually the desired result was achieved.

Setting-up ?

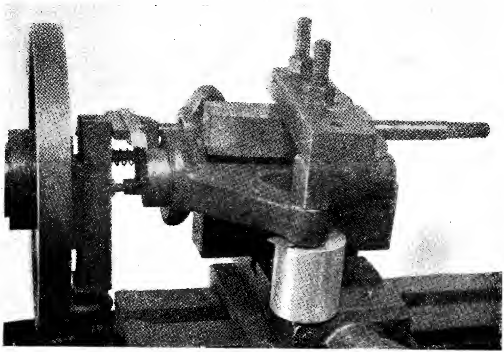
Incidentally, some readers have occasionally criticised the methods of setting up illustrated in the writer's articles, in which heterogeneous bits of scrap material are utilised for packing or holding down the work. Undoubtedly, it would be better and more workmanlike to use a properly designed clamp or packing-piece for each job, and in manufacturing practice, this would not only be justified, but also essential to efficiency. But the problems in the model machine shop are so diverse that a most formidable array of these fittings would be necessary, and even then it would probably be found that many jobs might call for fittings specially designed to deal with them; one might spend all one's time in the production of such devices. In this, as in many other engineering workshop problems, the fittings and fixtures are simply a means to an end, and the end justifies the means. Success in engineering practice often involves free use of compromise and improvisation—in workshop language, plain " wangling "—and even in the best-equipped modern toolrooms, the use of a strip of tin or a cigarette paper is not despised.

Packing

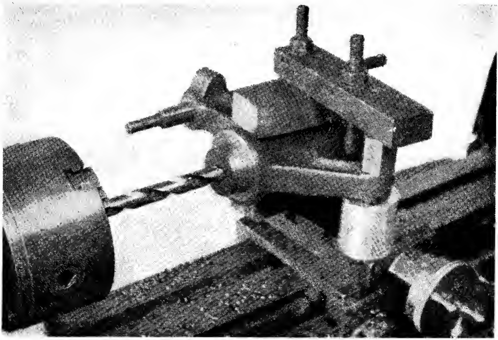
Hardwood packings are things which must be used with discretion, because while the resilience of the wood is an advantage in obtaining fine adjustment of location, it is difficult to ensure that it does not yield still further under cutting stress and thus produce inaccuracy. Soft woods should never be used for location packings, but in some cases may be useful to equalise or distribute the pressure of the clamping straps on uneven surfaces of castings.

Having secured the casting to the cross-slide, it was decided to bore the spindle bearings first, because this would enable a mandrel to be fitted to the bore, to provide a check on the accuracy of subsequent operations. The casting had been previously marked out, and it was possible to locate the spindle centres at each end from the lathe headstock and tailstock centres: having done so, the gibs of the cross-slide were tightened so that inadvertent movement could not take place. It is always advisable to have the cross-slide and saddle-gibs fairly tight when boring, or otherwise machining work in this way, otherwise it may be found that the back-lash in the feed screws may allow of movement of the slides, with disastrous effect on accuracy; in a case such as this, the cross-slide may be locked positively by the gibs during the operations on each location, but, of course, slackened off for traversing between operations.

As the spindle bearings were not cored, it was necessary to drill them from the solid, using a $\frac{9}{16}$-in. drill in the lathe chuck, and opening out to slightly under ⅝ in. diameter (finished size) with a boring bar between centres. An old hand reamer was borrowed and used for final machining; as this was found to cut about 0.001 in. under size (a good fault in the circumstances) the bearings were lapped out to fit the shaft.

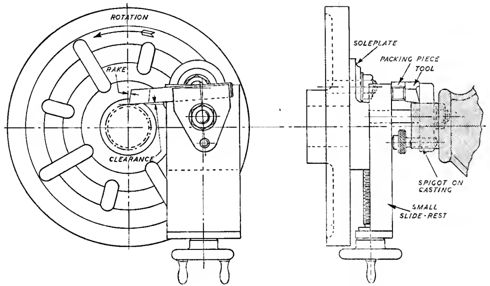


Another view of the spigot-turning operation



Drilling the hole in spigot to take tension stud

No bushes were fitted, as cast iron makes an excellent bearing for a high-speed drill spindle, and although lugs were provided on the bearings to enable them to be spilt and adjusting screws fitted, this was not considered either necessary or desirable. A mandrel was fitted to the bores after boring and reamering, as mentioned above, so that after traversing over to align the spigot centre, parallelism could be verified by measure-



Arrangement of small slide-rest on lathe faceplate for facing and turning the spigot of spindle-head casting

ment between the extremities of the mandrel and the lathe centres (the shanks, not the points, of the latter), using inside callipers.

An Improvised Facing-Head

In machining the spigot, it was highly desirable to have some provision for radial adjustment of the facing tool. It was originally intended to carry out this job by mounting the top slide of the lathe itself on the faceplate, but it was found that with the tool in the operating position, this would not swing in the gap; and while this difficulty might have been overcome by making up a special tool and holder, a quest for simpler and quicker means seemed desirable. Fortunately, a much smaller slide was available—namely, the one which belonged to an old $2\frac{5}{8}$ in. lathe which had been converted into a vertical milling machine, as described by the writer some years ago (Vol. 82, May-June, 1940)—and this was found to be capable of holding the tool in the required position, eliminating the need for making any special tools or fittings.

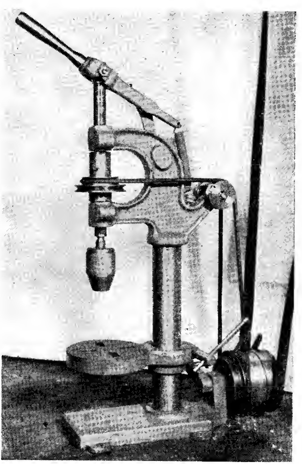
The slide was secured to the faceplate by its swivel bolt, and the tool so adjusted that it was presented tangentially to the work, as it would not be possible to swing the assembly with the tool arranged in the normal way. In this position, the normal front face of the tool becomes the top, and *vice versa*, so that " front clearance " and " top rake " are interchanged; but it was found unnecessary to alter the shape of the (more or less) normal right-hand side tool available. It was, however, necessary to extend the tool, in relation to the position of the slide on the faceplate, so that its point coincided with a centre-line parallel to the traverse of the slide, as shown in the drawing. The object of the packing piece under the tool was to allow the latter to operate without the tool-post stud fouling the casting when working on the spigot flange; otherwise it would have been necessary to cut off the end of the stud, or use a specially shaped tool. As the lathe was run at its lowest back-gear speed for this machining operation, it was unnecessary to counterweight the faceplate to obtain correct balance of the assembly.

The actual operation calls for little comment, as it was quite straightforward, though it had to be handled cautiously, as the possibility of shifting the casting under a heavy cut was by no means remote, in spite of all measures taken to secure it as firmly as possible. After roughing down both the parallel spigot and its seating flange, a careful check was made to ensure that this had not taken place, before proceeding with the finishing cut.

The flange was faced by first adjusting the slide so that the tool cut on the outer edge, then after two or three turns of the lathe mandrel, the slide was readjusted to reduce the radius of the tool point, and so on until the full radial width of the flange was dealt with; the saddle, of course, being locked stationary during this process. It would be quite feasible to operate the slide feed automatically without stopping the lathe, by fitting a star wheel on the feed-screw, and arranging a stationary pin to intercept this, so as to produce partial rotation on each revolution.

A device in which this method is applied has already been described by the writer (THE MODEL ENGINEER, November 9th, 1944). In the present case, however, it was not considered worth while to fit up automatic feed for a single operation. The radial adjustment of the slide was also used to obtain the correct diameter of the spigot to fit neatly inside the column tube, but in this case, of course, the saddle feed was used for traversing. A cut was also taken across the end face of the spigot, and the centre was finally drilled and tapped to take the ½-in. column stud. It will be obvious that throughout all these operations on the spigot the cross-slide must remain fixed.

On the eventual assembly of the complete machine, it was found that the care taken to assure accuracy in machining had been repaid, as proved by checking up spindle and column alignment in the usual way. A photograph of the machine, fitted up and ready for use, is reproduced on this page.



The finished drilling machine fitted up for use

The Moral

There is, as a matter of fact, more than one moral in this story. To the amateur or professional designer of machine tools, or any other engineering product, large or small, the moral is: always study how the particular components are to be machined, and the equipment available for producing them. The simplest forms of design, and methods of machining, are always the best, provided only that they produce the desired results, and do not in any way limit or impair efficiency or utility. It is all too common to find a component designed in such a way that it gives the machinist a headache, and takes far longer to machine than necessary, when it might have been considerably simplified and cheapened, perhaps even improved for its intended purpose, by a little thought on the part of the designer or draughtsman. In the most efficient engineering shops there is always a close liaison between design and production departments, but many examples are encountered where co-operation is sadly lacking.

To the machinist, the moral is: never spare any pains to ensure that accuracy is positive and beyond suspicion. No matter if a five minutes' machining job takes five hours to set up, if by so doing it is done properly and the risk of error eliminated. It is sometimes possible to fake or botch up a job which has been incorrectly machined, but it often takes far longer to do this than it would to carry out the job properly in the first place; and no good engineer could ever be proud of the finished result, anyway.

To model engineers generally, the moral is: always have a clear idea of how to tackle the machining operations on a set of castings or components with the equipment you have available, before undertaking construction. Wherever possible, ascertain if the designer has actually built the model from these components with limited equipment, and has taken pains to arrange the design and plan machining procedure to simplify and facilitate all operations. There is no advantage in fancy shapes, or elaboration for its own sake; but crudity or ugliness does not necessarily constitute simplicity in construction. Neither does efficiency depend on using the greatest number of parts, or the most difficult machining processes.

One cannot, however, escape entirely from difficulties in engineering production, however much care is taken in design; and indeed, many model engineers find their greatest interest in the surmounting of such obstacles. The more difficult the task, the greater the satisfaction of achieving success.

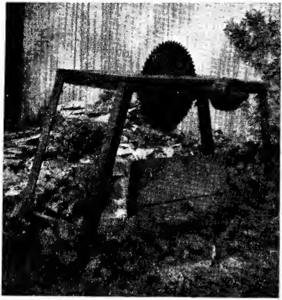


Fig. 1. Details of saw bench, showing bolted connections

A Model Engineer's Steam Saw-Mill

by

Ronald H. Clark, A.M.I.Mech.E.

MANY devout readers of THE MODEL ENGINEER will remember reading in Vol. 69, page 319, of the reciprocating cross-cut saw made by my late father from odd bits and pieces, which was necessitated by his acquiring a quantity of firewood from a dismantled windmill.

Very recently I found myself in the same position, viz. several tons of "tops" this time—not seasoned timber over 100 years old, which to saw by hand was impracticable and, more to the point, something I couldn't face! So a power-saw was the only solution.

I straightaway designed the simple circular saw depicted in Photo 1, having an 18 in. diameter circular saw-blade mounted on an orthodox spindle in medium-duty plummer blocks bolted beneath a ⅜ in. thick top (3 ft. 6 in. × 1 ft. 6 in.) of best quality boiler-plate. The edges are strengthened all round by 2 in. × 2 in. × ¼ in. angle bolted on, all bolts through the top being countersunk on the top side. The legs are also of 2 in. × 2 in. × ¼ in. angle notched and splayed to form feet drilled ⅜ in. clear for H.D. bolts when required. Leg bracing is of ⅜ in. diameter bars nutted each side of the angle face. Bolted connections instead of welded are used throughout for the obvious reason that, should any member of the structure become damaged or bent, it can be replaced more easily.

The drive is by a 3 in. wide × three-ply balata belt × 25 ft. long, woven endless, driving a 6 in. diameter fast pulley on the end of the saw spindle. No fast and loose pulleys are necessary because, when no stops and a lot of cutting is to be done, it is just as easy to stop the engine.

This engine, needless to say, I regard as one of my most treasured possessions, and two views of it are to be seen in Photos 2 and 3. Three years ago, I discovered it beneath an old tarpaulin in a large tithe barn in an isolated Cambridgeshire village, and I fell in love with it at once. Unfortunately, the owner was unmoved by my prayers and entreaties to sell but, in May, 1947, I called on one of my periodic worryings and found the concern had changed hands and, as the new owner was a reasonable man, the little engine came home on a lorry early in July last year.

It was made by William Tuxford & Sons, of Boston, *circa* 1890, and is an example of their standard 1½-n.h.p. agricultural portable engine of the period, the cylinder being 4¾ in. × 8 in., using steam at 65 p.s.i. Maker's number 1283. The boiler barrel is 4 ft. long over tube-plates, and 1 ft. 5 in. diameter. Tubes 18 in. × 1⅜ in. o.d., swelled to 1⅝ in. at smokebox end. Firebox 9½ in. deep by 16 in. wide by 20 in. high. Firehole 8 in. diameter. Firebox plates 7/16 in.

As I acquired it, it was found that new tubes, smokebox and chimney were required, the rest of the engine being in good order mechanically, and only stripping, cleaning, oiling and adjusting of the moving parts was necessary. It had not been used since 1930, but was laid-up without being cleaned or the boiler scaled, with the result that 30 lb. of scale was removed from the interior of the boiler and firebox when the tubes were out. Both shell and firebox are in sound order with no wastage greater than ⅛ in. anywhere.

The boiler is fed by the feed-pump mounted on the right-hand side of the smokebox, and eccentric-driven off the crankshaft. The actual delivery-pipe from the pump passes through the hot smokebox and into the boiler at the bottom of the smokebox tube-plate on the left-hand side. There is an extra ball-check

(*Continued on page 248*)

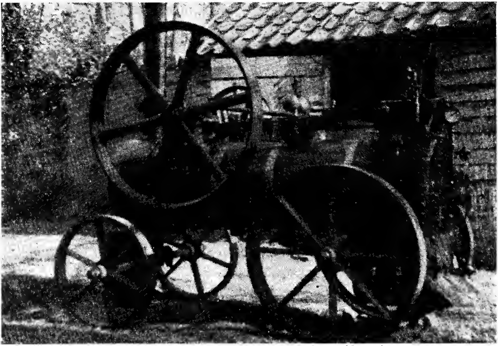


Fig. 2. Near-side view of the Tuxford portable engine

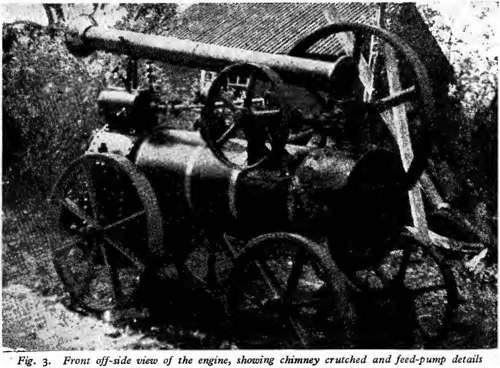


Fig. 3. Front off-side view of the engine, showing chimney crutched and feed-pump details

Old-Time Craftsmanship

by "L.B.S.C."

It is "Doris's" turn to take the stage this week, but the next item is the valve-gear, and, unfortunately, I haven't yet finished the drawing. I have had a real "plateful" of valve-gears just lately, what with three for the "Maid of Kent"—link for inside and outside cylinders, and Joy—link and Joy for "Minx," and the inside and outside gears for a Southern "professional," Mr. Atkins Stover, of 71, Quay Street, Brooklyn, N.Y., the date being approximately 1893. As can be seen from the photos, she was a pretty correct representation of the type in use on the New York and New Haven line (now the New York, New Haven and Hartford R.R., the main line of which—partly electrified, alas!—passed through the small

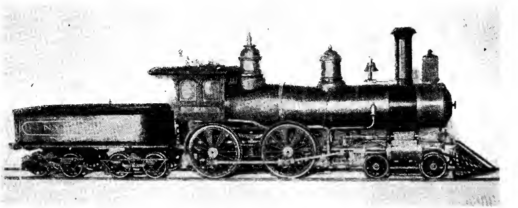


Photo by] *A typical American old-timer* [*A. C. Milburn*

"Schools" class engine. The old saw says, "Familiarity breeds contempt," but it doesn't always pan out that way; far from contempt, I have a mighty big admiration for valve-gears and as I want the gear on young "Doris" to be as efficient as that on her big sisters, it isn't any use unduly rushing it. Therefore, let us have a walk through an imaginary picture gallery, and take a look at what a couple of old-time craftsmen could do. For the photographs and information, I am greatly indebted to friend Al Milburn, of Milford, Conn., U.S.A. In the letter he enclosed with the pictures, he said that a visitor from Fairfield, Conn., was in his shop and saw his locomotives. Readers who follow these notes will recollect Al's "Lucy Anna," and the "Atlantic" now in the process of being carved out of solid steel. Well, this visitor said he had two old locomotives up in his attic, which originally belonged to his grandfather, who was by way of being a millionaire, and lived at Cornwall, Pennsylvania. The road on which they ran was laid on ground level, and was a purely "scenic" line; in those days, the idea of live passenger-hauling by locomotives of such a size would have been dismissed as ludicrous. Al went and saw the engines, got busy with his camera, and here you see the result.

A Few Details of the 4-4-0

The American type engine was built by a town where I lived when over the big pond), and is about $\frac{7}{8}$-in. scale, with a track gauge of 4 in. She has correct bar-frames, and working leaf springs, with equalisers between the coupled wheels, the latter being balanced in accordance with some builders' current practice at that time. They are $4\frac{3}{4}$ in. diameter, the bogie wheels—or pilot truck wheels as our cousins call them—being $2\frac{1}{8}$ in. diameter, the total engine wheelbase being $18\frac{7}{8}$ in.

The cylinders are $1\frac{1}{4}$ in. bore and 1 11/16 in. stroke, with slide valves on top, operated through rocking levers by Stephenson link-motion. As can be clearly seen in the close-up, the "period" crosshead pumps are fitted between the guide-bars and the frame, delivering into "coffee-pot" clacks or check-valves on the side of the boiler barrel. The boiler is of correct locomotive type, with a barrel $3\frac{7}{8}$ in. diameter, the grate area being 4 7/16 in. long by 2 7/16 in. wide, but there isn't any actual grate, as the boiler is fired by a spirit burner. There is no pressure gauge, or water gauge, water-level being ascertained by a couple of try-cocks on the backhead. The boiler is made of brass throughout; friend Milburn doesn't say anything about the construction, but it is a fairly safe bet that it is riveted and soldered.

The tender trucks are of the period pattern, and certainly don't look as though they were made in the proverbial five minutes, as they have

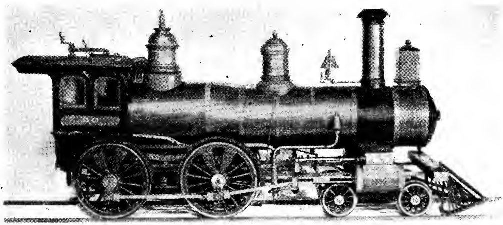


Photo by] [*A. C. Milburn*

Note throttle handle on cab roof, and divided balance weights

working leaf springs and are fully equalised. The wheels are $2\frac{1}{4}$ in. diameter, with a total wheelbase of $11\frac{3}{4}$ in. Other details are: height from rail to top of chimney $12\frac{3}{4}$ in., height of cab 10 in., width over cab $5\frac{5}{8}$ in., and total length of engine and tender 45 in. As the engine is at least 55 years old, it is probable that the old craftsman who built her has long since crossed the Great Divide, but the job is a fine record of an old-timer's skill. When I saw the pictures, and examined them closely in conjunction with the details given in Mr. Milburn's letter, I thought what an interesting job it would be to convert her to a coal-fired passenger hauler, without altering her appearance in the least. It could easily be done, same as I did with old "Ancient Lights."

"La Belle Parisienne"

The ancient French tank engine is a typical representation of the sort of thing Jacques and Yvette used to see in their courting days. She is the same scale and track gauge as her American contemporary, and was made by a M. Radiguet, of 15, Boulevard des Filles du Calvaire, Paris, who was justifiably proud of his fine handiwork,

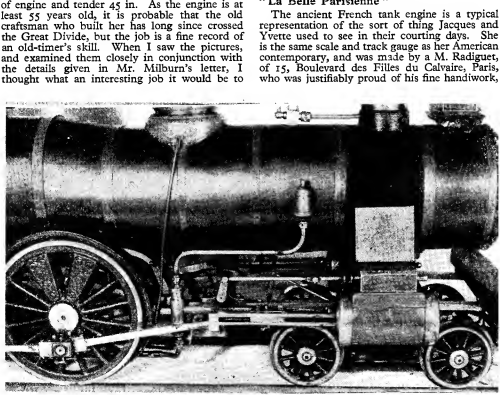


Photo by] *Close-up of the "works"* [*A. C. Milburn*

and engraved his name and address on the urn-like dome. Mr. Milburn photographed it full size. She is also a spirit-fired job with a brass locomotive-type boiler; and as she carries the alcoholic refreshment in a tank in the bunker, and feeds it into a sump below, which supplies the burners, the water tank is placed between the leading and trailing axles, and shaped so as to clear the driving axle, which carries an eccentric link-motion, the links operating the valve forks direct, without any intermediate valve rods, guides, suspension levers or what-have-you. This necessitates the weighbar shaft being placed right up against the smokebox, and an extraordinary long reach-rod. Like some of the British locomotives of about the same date, "La Belle" apparently goes in the opposite direction to the lever, as the fore-gear eccentric

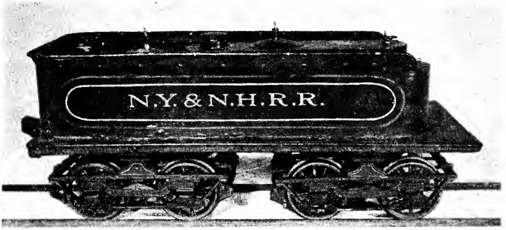


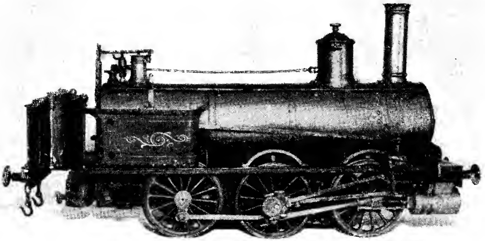
Photo by] *The 4-4-0's tender* [*A. C. Milburn*

for the feed-pump. This component is mounted upside down on the underside of a saddle between the cylinders. The boiler is $3\frac{1}{2}$ in. diameter and 15 in. long, minus steam and water gauges, and plus try-cocks, same as her American sister. Note the spring-balance safety valves over the firebox, and the regulator rod, which runs between the valves, over the top of the boiler, and enters the "tea-urn" by a studded gland.

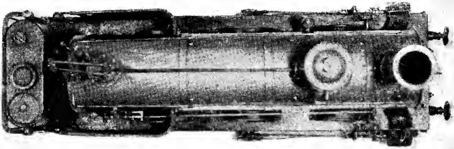
The cylinders are $\frac{7}{8}$ in. bore by $1\frac{3}{8}$ in. stroke, with overhead valves working in inclined steam-chests, and operated by outside Stephenson link-motion, with eccentrics mounted on a return crankpin. What with that, and the external regulator rod, this old girl sported the "New Look" over half-a-century before the London Midland Region of British Railways ever thought of it! The six wheels are all $3\frac{1}{2}$ in. diameter, with a wheelbase of $8\frac{1}{4}$ in.; obviously she was meant for a six-coupled engine (I have some old pictures showing similar machines with all wheels coupled), but the little one is a 2-4-0 with no coupling-rods between the leading and driving wheels. The wheels themselves are brass castings, with steel tyres shrunk on, and the driving wheels have no flanges; a rather unnecessary provision on an engine with such a short wheelbase. The axleboxes are all sprung, but are not equalised. Points of interest to present-day locomotive builders, are the "open-work" splashers, the reversing lever with horizontal "grips," and the arrangement of the is leading the crank (clearly shown in the broadside view), and the rod is coupled to the top of the link. To lift the link and reverse her, the reach-rod would have to be pushed forward; and the way it is inclined, it is obvious that it is connected to the lever above the pivot, and moves the same way, so the engine would suit a driver named Mike, rather than one named Jules. Incidentally, the lifting-link has a double right-angle bend in it, to clear the valve fork, and it is connected to the link by an extension of the bottom or back-gear eccentric-rod pin; a dodge I used on the "Maid" and "Minx" to save the trouble of fitting lifting blocks to the expansion links. At one time it was widely used in full-size practice.

Another interesting point is apparent from an examination of the broadside view. The engine was not intended for a tank engine at all, but a tender engine; look where the main frames end, just behind the side fenders. The part carrying the spirit tank was obviously tacked on as an afterthought, otherwise the main frames would have run right back to the buffer beam. She is $19\frac{1}{2}$ in. long over beams, 7 in. high to top of boiler, $10\frac{3}{4}$ in. from rail level to top of chimney, and $5\frac{1}{2}$ in. wide, not much for a 4-in. gauge engine. She isn't a bad-looking old iron at all, and I'd just love to put a few monkey-glands into her, and see what she could do in the way of pulling a live load. In conclusion, I propose a hearty vote of thanks to Al Milburn for his trouble in taking the photographs and getting

the details mentioned above. In his letter he said that it was a matter for wonder how the old-time craftsmen managed to turn out such jobs with the kind of equipment available in those days, and I heartily agree ; but they had the two main essentials which even today cannot be beaten, viz. a steady brain and clever hands, without which *nothing* could be done ; nuff sed ! with his old L.M.S. uniform cap and overalls, and for a couple of hours we went back into old times. Our worthy friend duly examined the little compound, and commented favourably on her, after which we got up steam, and he put her through her paces, as in full-size in the old days. When he first started to fire her, he was a bit surprised when I said that was enough,



A Parisienne of the 'nineties



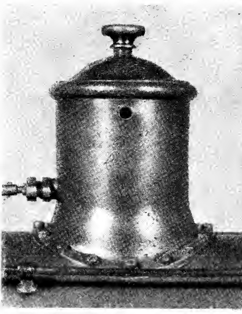
Photos by] *Aerial view of " La Belle "* [*A. C. Milburn*

A Different Bit of " Old Times "

We had an interesting evening on my little railway recently, one which I shall always remember. It came to my knowledge that Driver L. A. Earl, who retired from the L.M.S. top-link at the end of 1946, after breaking every speed record and half the dining-car crockery on that line, used to fire on the L.N.W.R. compounds in his early days ; so I asked him to come and drive " Jeanie Deans " and see what he thought of my improvements. A mutual friend who has a gasoline cart, duly brought him along, complete after three shovelfuls had gone in ; the big ones took a bit more than that ! He made a splendid show with her, on a run of a little over two miles, and passed her O.K. with a special " pat on the back " for the injector. Our mutual friend took several photos of an old L.N.W.R. driver with a modernised L.N.W.R. locomotive, and himself remarked that it was a wonderful sight to see the effortless way in which little " Jeanie " did the job, running at high speed without a sound from the exhaust, a mere trickle of steam drifting over the lip of the chimney as she

knocked off lap after lap, with a white feather at the safety-valves all the time. He also said that he had been to dozens of club track meetings, but had never before seen an engine that gave no trouble whatever in getting up steam (which took 3 min.) and maintaining it without even touching the fire with a pricker.

After the run was over, we had a bit of a chinwag, and—well, you can bet that two old enginemen, off different lines, found plenty to talk about! We compared notes on the different methods of driving, Bro. L.M.S. explaining how he humped 500 tons out of Euston up the Camden bank with a "Duchess" or "Princess" (he had the "Princess Royal" new), and I told him how we got out of Victoria up to Grosvenor Road Bridge, with 150 lb. of wet steam operating one solitary pair of driving wheels carrying between 15 and 17 tons. He said the L.N.W.R. got a fearful shock when our 10-wheel tanks worked the "Sunny South" express through from East Croydon to Rugby without taking water. The meeting was brought to a termination by the same old enemy who used to chase us on the footplate, viz. Inspector Time, so after a cup of the enginemen's best friend, we parted. It was the most enjoyable evening I've spent for many a long day.



"*Ye olde tea urne*"

A Model Engineer's Steam Saw-Mill

(*Continued from page 242*)

valve near the tube-plate besides that in the pump body itself. By passing the cold feed through the hot smokebox it is preheated.

Governing is carried out by the Watt-type governor belt and bevel driven off the crankshaft, the governor sleeve operating a butterfly valve between the regulator and the valve chest. It is interesting to note that this governor is substantially the same as that patented by Watt in 1788.

Although rated at $1\frac{1}{2}$ n.h.p. a simple calculation shows the developed i.h.p. to be about 5.05, giving a fair maximum of about 4.5 on the saw when logs up to 7 in. diameter can be cut. This required the full working pressure, but even with only 38 p.s.i. on the gauge the little fellow will pull the saw through 3 in. green alder and ash *ad lib.* The heating surface I estimate to be 35.98 sq. ft., giving 23.95 sq. ft. per i.h.p. This compares conservatively with later engines, as, for example, those by Charles Burrell & Sons Ltd., who allowed 19 sq. ft. of heating surface per n.h.p. Firing up with one part "Coal Board coal" and three parts sawdust and short ends, etc., gives 10 lb. on the gauge from cold in 40 min. and it blows off in another eight.

Some of the more interesting fittings comprise a Salter safety valve with ferrule and graduated scale set to blow off at 65 lb., water-gauge glass, $\frac{1}{2}$ in. blower pipe and cock, new brass lagging bands (the old were of wrought iron, not contemporary and I removed them), whistle and two try-cocks.

All work on the engine including withdrawing old tubes, refitting the new, fitting new lagging bands, cleaning, adjusting, repainting, fitting new smokebox and chimney (using the old original hinges and flanges), and descaling the boiler occupied about eight week-ends during the torrid period last summer instead of going to the seaside, but the large heap of fuel for next Nowell made the effort well worth while and a pleasure. The soft whisper of a nut run by hand along its bolt-thread of nearly fifty summers proved a joyous sound.

The upper try-cock is very useful as by attaching to it a piece of canvas and rubber hose I can steam my own and my late father's collection of historic and modern models and really run them under steam. We read so much in THE MODEL ENGINEER about "model-making" and preserving the result for ever under a glass case and so very little about "model running," that I feel quite original in running my steam engine models by steam! Even with these distractions I can manage to cut up half a ton of firewood during a Saturday afternoon and evening, to say nothing of the great pleasure and joy one derives from running such a delightful little plant.

In conclusion, I would mention the whistle. I use it to give one piercing blast to warn my enthusiastic partner I am coming in for tea or knocking off for good. I also use it to give two piercing blasts when some society offender brought up entirely upon the soulless, noisy and unromantic I.C. engine bleats "it goes by steam!"

Adding Moon and Date Indicators to a Clock

by Chas. Blazdell

*"Let there be lights in the firmament of the heaven . . .
And let them be for signs, and for seasons, and for days and years."*

THE passage of time having been measured from the remotest period—as it is to the present day—by the apparent motions of the heavenly bodies, it was natural that on the invention of the wheel-driven mechanical clock, a feature should be made of astronomical phenomena. Some of the very early clocks were, in fact, more concerned with showing the positions of the sun, moon, and planets than with "telling the time" in the modern sense of the phrase. It was not until the middle of the seventeenth century, however, that the practice of adding lunar and calendar work to English-made domestic clocks originated. Many of these clocks

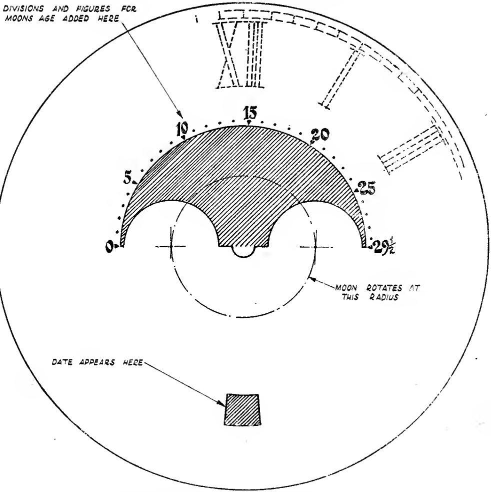


Fig. 1. Showing shaded portions cut out of original dial to expose moon and date

have survived to the present day, particularly in the long-case or grandfather type in which a separate dial shows the phases and age of the moon, and some form of indicator on the clock dial itself gives the date. With the introduction of printed calendars and mass-produced clocks, the practice of including such indications on ordinary clocks and timepieces seems to have been discontinued.

a glance at a clock so fitted, besides indicating the moonlight nights, will give a rough idea for those living near the sea or tidal waters of the time of high water and height of the tide. Although, in the present instance, the conventional method of showing the moon as used in the old clocks has been followed, there is no reason why something more elaborate should not be attempted. For instance, with electricity

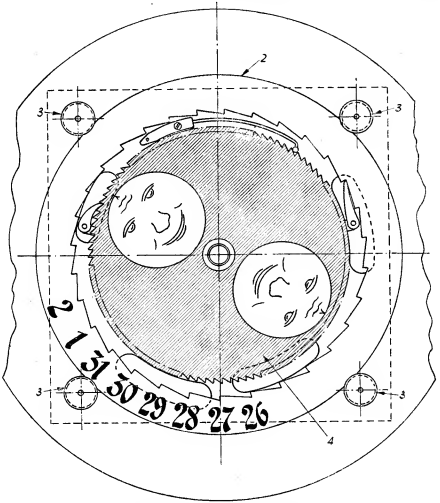


Fig. 2. View with dial removed

Of course, we no longer believe in the influence of the moon in human affairs, that, for instance, the successful gardener must take note of the moon before sowing his peas,* nor that the phases of our satellite have any predictable effect upon the weather.

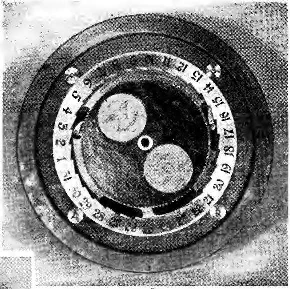
Still, a moon dial adds interest to a clock, and the making and fitting of such a dial to an existing clock affords scope for some little mechanical ingenuity and artistic ability. Also,

*" *Sow peas and beans in the wane of the moon, Who soweth sooner he soweth too soon.*"

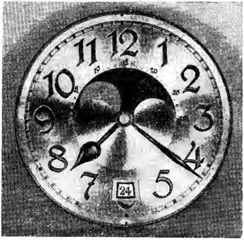
available, a translucent material could be used for the moon dial and the moon and blue sky illuminated from the back with a small low-wattage lamp, giving a rather attractive and pleasing effect. Or, in the case of a clock which allowed of it, the moon might be mounted above the dial and take the form of a solid sphere—similar to a billiard ball—one half being white and the other dead black. Alternatively, the sphere might be hollow and of a white translucent material with one half rendered black and opaque. The solid sphere illuminated from the front or the

hollow one from the interior would give a much more natural representation of the phases as it was rotated by the clock than the conventional flat disc. The day of the week and the month might also be included if desired, as well as the date.

Clocks vary so much in size and type, however, that the exact method of making the necessary additions must be suited to each individual case, the greater the space available the easier the job. The writer's clock was a modern "Grandfather" type movement of continental manufacture with a 10-in. dial. After making a case for same and fitting quarter chimes, the present additions were decided upon. To avoid interfering in any way with the existing clock movement, the whole of the additional mechanism was arranged to be self-contained and is all mounted on the back of the dial.



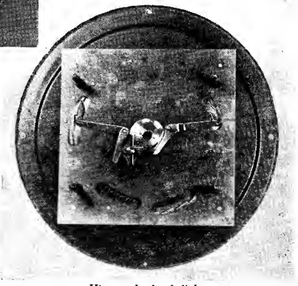
View with dial removed



View of altered dial

The only addition to the original clock movement is the driver (p) Fig. 4A, attached to the hour-hand pipe by a set-screw.

The drawings show the arrangement better than a written description. From these it will be seen that the original clock dial, Fig. 1, was cut away to show the moon, which, together with the date indicator, rotate about the same centre as the hands. Fig. 2 is a view of the added mechanism looking from the front with the clock dial removed, and Fig. 3 is a view from the back. These three figures are to scale. Figs. 4A, 4B, and 4C, are diagrammatic only and not to scale. The annulus (2) has the dates 1 to 31 marked upon it and is carried by the four small rollers (3), which are made as nearly frictionless as possible. The rollers are of brass, rotating on small shouldered steel studs riveted into a reinforcing plate attached to the back of the original dial. The annulus was cut out on the lathe faceplate from 18-gauge brass and the 31 teeth filed. After a dull chromium plating, the figures were written on with waterproof Indian ink. Duralumin plate would also be suitable and avoid plating.



View at back of dial

The moon dial (4), was of 22-gauge brass, the 118 teeth being cut with a fine-tooth saw and filed. Dividing was done by drawing a circle, about double the size of the finished disc, on a sheet of paper. The metal disc drilled with a pin hole in the centre was centred on the paper with a pin driven into the bench. The paper circle having been carefully divided with drawing instruments and the whole fixed against rotation, a straight-edge was held in contact with the pin and moved to each division in turn, and the position transferred to the metal with a scriber.

The pin hole was afterwards enlarged and a hollow centre sweated on, this in turn rotating freely on a hollow pivot riveted to the dial reinforcement. The spindle and pipe carrying the clock hands pass through this pivot without touching same.

The moons were painted on with white enamel, the sky being turquoise blue, an impression of clouds being given with a mixture of both. Those with artistic ability can improve on this and also embellish the moons with nicely painted faces!

Although rotating round a common centre, both moon and date indicators are, of course, independently carried and driven, the date ring making one revolution in 31 days, and the moon disc one revolution in 59 days. The date must be advanced one day every 24 hours, preferably at midnight, and as the hour hand makes two revolutions during this period, some form of 2 to 1 gear is called for.

The writer used the arrangement shown on the drawings to accomplish this, which, as will be seen, is an adaptation of the "Geneva movement." Admittedly, this is an unnecessary complication, but it is an interesting piece of mechanism to make and avoids the trouble of cutting toothed wheels. Fig. 4A will explain the action of a "Geneva movement" to those unfamiliar with it. The lettering is the same in all the figures. The disc (a) rotates on a hollow centre (not shown) through which the spindle and pipe for the clock hands pass. As viewed from the back of the dial, the disc rotates anti-clockwise, being rotated once every 12 hours by member (p) on the hour hand pipe through the driving pins (b). The arms of the cruciform member (c) have slots (d) and (k) into which the driving pin (e) enters. The circular part (f) of the driving disc fits closely between the arms of the cross, so locking it positively against rotation, except during the short time the pin (e) is engaging a slot, when the disc is cut away at (g) to permit the passage of the arm across it. It will be seen that the pin while passing through the slot rotates the cruciform or driven member — now unlocked — relatively rapidly through 90 deg., and on passing out of

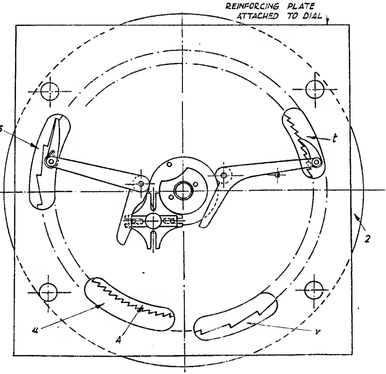


Fig. 3. Mechanism at back of dial

the slot the driven member is again locked by the driver. It will also be seen that the driver makes four complete revolutions to one of the driven member. The crossbar (h) with its two pins (j) and (l) is fixed to and rotates with the driven member (c). The action of the complete mechanism may be followed from Fig. 4B. Being viewed from the back, disc (a) appears to rotate anti-clockwise. Sometime before 12 noon, pin (e) enters slot (k), turns cruciform member clockwise through 90 deg. at noon and re-locks it. In so doing, pin (l) recedes from bell crank A which drops on to boss (m), allowing pawl (n) to fall and engage next tooth of date ring. But note that no movement of the date ring results, as being mid-day such is not required. Somewhere about 3 p.m. pin (e) in its motion engages tail of bell-crank B, and in passing it raises pawl (o) one tooth and lets it drop again. This advances moon dial half a day, any unwanted movement of moon dial being prevented by lightly loaded detent (p). Continuing its journey, pin (e) enters next slot in "Geneva plate" some time before midnight turns it through 90 deg. and again re-locks it. This time pin (j) engages tail of bell-crank A, raising pawl (n) one tooth and locking it there, so advancing date by one day. The adjustment is such that the motion of pawl starts about 10 minutes before midnight and is completed by 12.30 a.m. By 3 a.m. pin (e) has again reached bell crank B, raising pawl (o) another tooth and lowering it again, so advancing moon another half day. It will be seen, therefore, that with this mechanism the total result of two revolutions of the hour hand—that is, each 24 hours—the moon is advanced twice, half a day each time, and the date moved once only at midnight, which is the action desired.

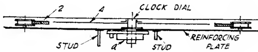


Fig. 4C. Sectional plan

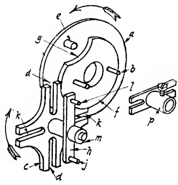


Fig. 4A. Position of mechanism approaching midnight

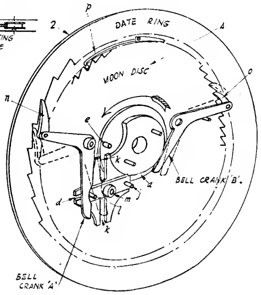


Fig. 4B. Position of mechanism approaching noon

As previously mentioned, the exact method of fitting the extra mechanism must depend upon the design of clock and the space available. With the arrangement shown, the moon disc and also the date ring must both be in the same plane, and lie immediately behind the dial. This is possible because the disc, being smaller than the ring, can rotate within it. Behind these two is a reinforcing plate added to the original clock dial. A hollow pivot riveted in the centre of this plate projects through both sides, the front carrying the moon disc and the rear the Geneva disc, the spindle carrying the clock hands passing through the centre (Fig. 4C). The bell cranks A and B are mounted on the rear side of the reinforcing plate on studs riveted into same, and slots (s) and (t), Fig. 3, cut in the plate allow the pawls (n) and (o) to engage the moon and date members on the front side. Additional slots at (u) and (v) allow of setting both moon and date with the fingers, as in this clock there is sufficient room to pass the fingers up between the back of the dial and the front plate of the movement. This is convenient, as at the end of a month with less than 31 days the date must be advanced by hand.

The mechanism above described has now been working for some two years with no failure and no apparent effect on the time-keeping of the clock.

*A 1.5 c.c. Compression-ignition Engine

by "Battiwallah"

CHUCK the disc so that the central hole runs quite truly ; this is easily checked by putting a short stub of $\frac{1}{8}$-in. material in the centre hole and adjusting the chuck jaws until this stub runs true. Then bore out the centre of the disc to $1\frac{1}{16}$ in. Counterbore to a diameter of $1\frac{3}{8}$ in. for a depth which will leave the thickness of the remaining material at $\frac{1}{4}$ in.

Now take a $1\frac{1}{2}$-in. length of $1\frac{1}{2}$-in. diameter round mild-steel rod, square up the ends in the lathe and drill right through longitudinally $\frac{7}{16}$ in. diameter. Whilst the piece is still chucked, with an accurately centred tool in the slide-rest, scribe a line along thc length of the piece either side so that the two lines are 180 deg. apart. Remembering that there is not much metal to spare on the piece at the position of its maximum diameter, carefully saw the piece in halves longitudinally, using the lines as a guide. Then carefully face the two halves where they have been separated, so that they fit together without any appreciable rock ; filing is the easiest way to do this. Then solder the two halves together so that they register as accurately as possible. Now comes a rather tricky job. It is to mount the work in the lathe four-jaw chuck so that the high and the low parts run in such a way that, in restoring a circular section to the work, a minimum of material is wasted; for, we repeat, there is little metal to spare. The easiest way to do this is to use a tool in the slide-rest as a gauge. Turn the work, after chucking it as accurately as can be judged, so that the highest spot is adjacent to the tool point and then turn the work through 180 deg. Note the distance between the tool point and the work and, by adjusting the chuck jaws, bring the work towards you by half this distance. After a few adjustments like this, the work will be sufficiently accurately adjusted, so far as the diameter being worked is concerned, and by repeating the process on another diameter at 90 deg. to the first, the work should be chucked so that a minimum of material is removed from the maximum diameter. Remember, by the time the piece has been split and faced and soldered, it is rather "eye" shaped in section.

Now turn to such diameter that the end just fits comfortably and tightly in the counterbore of the first piece you have made, i.e., to the $1\frac{3}{8}$ in. dimension. Do not take heavy cuts—if you do the work will, in all probability, be thrown out of centre and the soldered joint broken. Next, with a boring-tool bore right through and finish at 17/32 in., giving the bore as smooth a finish as you can. Now chuck the job in the self-centring chuck and step the piece to the drawing, Fig. 3. The purpose of removing this metal is to lessen the heat requircd to bring the die to the right tempcrature for pouring, and also, of course, to get a fixing for a header of reasonable area. There is no purpose in having this too largc, for it will mean heating up more metal than necessary.

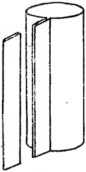


Fig. 4. Die headers

The header is simply a piece of thin sheet iron bent round a $\frac{3}{4}$-in. diameter rod as shown in Fig. 4. The U-shaped piece is bent up from the same sort of material and, when it is pinched on to the lugs of the round part, the latter will be quite firmly held on the upper part of the die, which is turned down to $\frac{3}{4}$ in. diameter. If it does look as though molten metal will escape between the header and the die, a little fireclay will stop it.

The Crankcase Die

The working drawing for this is shown in Fig. 5. It looks quite a conglomeration of bits and pieces, but it is not really a very formidable job.

From a piece of $\frac{1}{2}$-in. by $1\frac{1}{4}$-in. iron bar saw off four pieces which will finish to 2 in. long. On one side, face each one truly square ; filing is as good a way as any, unless you have the means of gripping the four at once and facing them either in a milling or a shaping machine. Also clean up one face of each piece sufficiently to enable the four pieces to be soldered together ; using a blow-lamp, this can be made the next job. Flux with Baker's fluid. You now have a block roughly 2 in. × $2\frac{1}{2}$ in. × 1 in. Now cut out two pieces of $\frac{1}{16}$-in. thick iron to finish 2 in. × $2\frac{7}{16}$ in.—these are the parts *B* in Fig. 5. On the centre of the soldered joint of the parts *A*, centre-punch the centre of the $1\frac{1}{16}$ in. bore ; grip the work in the vice while you do this or you may separate the parts. At the same time mark off the other drillings on the same face. Now drill at the first pop-mark at $\frac{1}{8}$ in. diameter for approximately $\frac{1}{4}$ in. deep and, using a $\frac{1}{8}$-in. peg inserted in this hole and the template in Fig. 2, mark off the drilling centres for the recesses in the die which will form the end-plate fixing lugs. When you do this, don't forget which side of the template was used for marking off the corresponding lugs for the end-plate die, or the registration of the castings may not be so good. Now, another point you must watch is to ensure that the $\frac{3}{8}$-in. diameter hole which forms the carburettor fixing boss is on the opposite side to the drillings for the lugs ; this is just a precautionary note, for it is so easy to trip up in little matters of this sort. The $\frac{1}{4}$-in. diameter holes for the fixing lugs can

*Continued from page 228, "M.E.," August 26, 1948.

now be drilled, but only in the top halves of the parts *A*. See that the drill does not go through to the lower parts; the drillings can be finished off with a file when the soldered joints are broken.

Now clamp one of the $\frac{1}{16}$-in. pieces at the bottom of the large block, and drill the four $\frac{3}{16}$-in. holes; reverse the large block and, with the other $\frac{1}{16}$-in. plate clamped at the lower side, put the $\frac{3}{16}$-in. holes through this. Mark the various parts so that they can afterwards be correctly assembled. By the way, if you have been too heavy-handed with the solder when joining the *A* parts together, the various holes will not register properly.

It is best to leave the drilling of the $\frac{3}{8}$-in. hole for the carburettor fixing boss until later on.

It is advisable at this stage to put $\frac{3}{16}$-in. nuts and bolts in position to firmly hold together the upper and lower *A* parts, for the next operation is boring out the $1\frac{1}{16}$-in. hole which forms the crank chamber. Mount the job in the four-jaw chuck so that the $\frac{1}{4}$ in. diameter pilot hole which was previously drilled runs quite truly, and the same goes also for the face of the job. And, of course, the parts where the work is gripped by the chuck jaws should have been filed square so that a firm grip is secured. If the *B* plate is attached to the main block at the side remote to that in which the $\frac{1}{4}$-in. holes are drilled, it can be bored out with the same operation, for the diameter of the bore in this plate is immaterial so long as it is greater than the bore of the part *C* which forms the pouring orifice.

Start boring operations by putting a $\frac{1}{4}$-in. drill right through the work; follow with a $\frac{3}{8}$-in. drill and then with a $\frac{1}{2}$-in. one. The idea of proceeding by easy stages is to avoid breaking the soldered joints. For the same reason, the boring process should be carried out by taking gentle cuts.

The next operation is the vertical bore; this entails mounting the piece on an angle-plate bolted to the faceplate, after the centre of the bore has been marked off. As it is important that this bore is truly at right-angles to the other bore, it is a useful dodge for truly mounting the work in the lathe to accurately centre the other end and drill say, 3/32 in. diameter for $\frac{1}{8}$ in. depth. The two centre marks will, of course, be on the soldered joint. Then, by keeping the lower centre (as viewed in the drawing) positioned by the headstock centre, when the other centre is

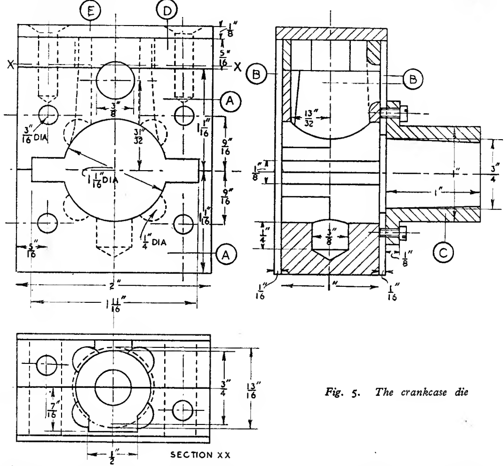


Fig. 5. *The crankcase die*

running truly, it is known that the whole job is running truly. The $\frac{3}{16}$-in. clamping bolts should be retained in position which means that packing pieces are needed to keep the bolt heads clear of the angle-plate. These packing pieces must be of equal thickness. Face the end so that the distance from the horizontal centre-line is $1\frac{1}{16}$ in.

Start the boring operation just as you did the other one, by successive drillings and again taking light cuts for boring. When the bore is nearing $\frac{3}{4}$ in. set the top-slide to give the taper indicated in the drawing, if this has not already been done.

Now it will be noticed in the sectional view that the bore has been continued at a lesser diameter at the lower part of the crank chamber; the purpose of this is to provide a gripping piece for chucking the casting, which is very useful. All that need be done is to put the $\frac{5}{8}$-in. drill through to the requisite depth when making the initial drillings, but don't let the drill go too far, for there is the final facing to $1\frac{1}{16}$ in. from the horizontal centre-line to be done.

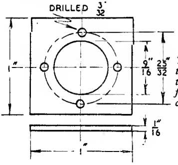


Fig. 6. Template for the crankcase top, cylinder flange, and cooling fins' drillings

The piece *D* is the next to be tackled, but firstly another template similar to that in Fig. 2 is needed, but it has a larger centre hole. Fig. 6 shows what is needed.

With this template mark off symmetrically the centres of the small holes on a 2-in. piece of 1-in. $\times$ $\frac{3}{8}$-in. iron bar. Then find the centre of these four holes and centre-pop it. This is a simple little job in geometry which hardly needs comment. Drill the four outside holes right through at $\frac{1}{8}$ in. diameter. Mount the piece in the four-jaw chuck and centre on the inner pop mark. Bore through parallel to $\frac{3}{4}$ in. diameter and finally face off at full $\frac{5}{16}$ in.

Remove the job from the lathe and drill the holes for the two countersunk screws and at the same time the piece of $\frac{1}{8}$-in. thick iron can be drilled to form the part *E*.

Put a stub of $\frac{3}{4}$-in. diameter material in the bores of the assembled *A* pieces and the *D* piece, so as to register them properly and mark off the set-screw tapping holes; the best way to do this is to clamp the parts together and to drill with a $\frac{3}{16}$-in. drill sufficiently to start the tapping drill. Tap these holes $\frac{3}{16}$-Whit. or 2-B.A. and secure the parts with the set-screws. The $\frac{3}{8}$-in. diameter hole which forms the carburettor fixing boss can then be drilled, and again, don't forget that it is on the side remote from the front end-plate fixing lugs, and that the *B* plate is not so drilled.

The piece *C* forms the filling orifice; it is just a simple turning job from a scrap of $1\frac{1}{4}$-in. round bar. The bore is slightly tapered to ensure that the casting draws easily. The plate *B* to which it is screwed with four $\frac{1}{8}$-in. set-screws should have a hole somewhat larger or it will not be possible to separate the casting from it. Before breaking the soldered joints, make sure that the various parts assemble properly and, if you are satisfied, the *A* parts can be melted apart and the solder cleaned off.

In the upper *A* part in which the end-plate fixing lug recesses are, file or mill out the $\frac{1}{2}$-in. wide flat which gives the additional metal where the transfer passage will be made in the casting. This flat should be arranged so that there will be a uniform dimension of 13/32 in. from its face to the centre-line of the die, shown in the sectional elevation.

The final job on this die is to file or mill the recesses in the four parts *A* which form the holding-down lugs of the casting. To ensure even surfaces on the casting, do this job with the corresponding pairs secured with the $\frac{3}{16}$-in. bolts and nuts. It only remains to make the header from thin sheet-metal as was done for the other die, but this time wrapping the sheet round a 1-in. diameter bar, and all is ready.

Nothing has been said about cleaning up the various faces of the parts of this die, other than was necessary for soldering. It is not necessary to do so, because ordinary stock is quite true enough for the various joints; indeed the slight imperfections of the joints enable the air to escape as the metal is poured, but the metal itself will not leak. This will dismiss the question —"how does the air escape?" Beyond taking the ragged edges off the outside of the die, further work is to no purpose, unless one desires to make a "posh" job of the die.

Making the Castings

The ways and means of melting the aluminium have already been fully explained, but before going ahead with the aluminium castings it is as well to make a trial with lead, for if anything is wrong with the dies, it is far easier to remove a lead casting than an aluminium one, assuming that there is a defect which would cause difficulty in removing the casting from the die. Provided the instructions have been followed, however, this will not occur.

If the check is satisfactory proceed to melt the aluminium. When the metal is well under way, place the die, that is whichever one it is decided to use first, against the melting pot and turn it occasionally so that it is evenly heated. The right temperature is a good deep blue. Do not have any part of the die at a red heat when pouring or there may be adhesions of the aluminium, for aluminium has an affinity for iron when both are hot. Keep the die up to temperature while the final stages of heating and skimming the metal proceed. Now you will have previously prepared a non-inflammable bed for the die when pouring—a sheet of asbestos is as good as any, though a metal sheet will do—and you will also have handy tongs with which safely to handle the hot die and the metal pot.

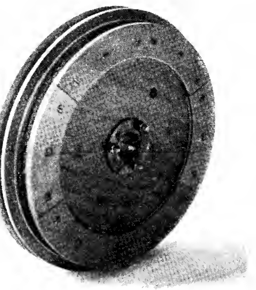
(To be continued)

A Stepped Pulley for a Whittle Belt

by K. N. Harris

I RECENTLY required a two-step pulley (for a lathe countershaft) in a hurry and as no suitable casting was available some form of fabrication was necessary. The outside diameters of the two discs were $9\frac{1}{2}$ in. and $8\frac{3}{4}$ in. respectively.

I decided on two discs of five-ply wood $\frac{5}{8}$ in. thick as the basis. The centres of the two steps were only $\frac{5}{8}$ in. apart, and as the belt itself is $\frac{1}{2}$ in. wide this meant that the rims of the wheel would be very weak, being only $\frac{1}{16}$ in. thick at the outer edge, and as the individual plies were $\frac{1}{8}$ in. thick, this in turn meant that these rims would inevitably split where the grain ran "with" the rim under wedging action of the belts, unless they were supported.



The completed pulley

First, the two discs were roughly sawn to shape on a jig-saw. Two circles were set out on the large disc, one $7\frac{1}{4}$ in. diameter, the other $3\frac{3}{4}$ in. diameter, and divided into six.

A $7\frac{1}{4}$-in. circle was also set out on the small disc and divided similarly. The discs were drilled for No. 8 wood-screws and countersunk. They were then screwed together in such a way that the six holes in the outer circles of the two discs were evenly stepped, care being taken to keep the discs concentric.

The unit was then mounted on a faceplate to run reasonably true and centred, a $\frac{3}{4}$-in. drill put through and the hole opened out to $1\frac{1}{4}$ in.

Next, two half-circles of 3/64 in. steel-plate were cut $4\frac{3}{4}$ in. radius and a half-hole 11/16 in. radius cut at their centres. A row of holes for small screws was marked out 11/16 in. in from the edge, drilled and countersunk. The wood discs were marked one to the other and taken apart, and the two half-plates screwed to the large disc with a coat of thick varnish on each, the assembly being carried out with the varnish wet. The wood-screw holes were then drilled through the iron plate, a coat of varnish applied to it and to the small disc, and that screwed in place, a temporary $1\frac{1}{4}$-in. mandrel being used to keep the two discs concentric. The holes in the small disc were continued through the iron plate and these screws, too, inserted.

The reason for two half-discs of iron instead of a whole one was the sufficient one that I had no plate handy large enough for a $9\frac{1}{2}$-in. disc.

A brass flanged centre was turned and bored and a large steel washer bored out $1\frac{1}{4}$ in. to suit. This latter had three holes drilled in it to take 2-B.A. bolts and was used as a jig to drill the flange of the brass bush. The flange was drilled edgewise, clearance for $\frac{5}{16}$ in. to within $\frac{3}{8}$ in. of the bore and then $\frac{5}{16}$ in. tapping, tapped Whit., and an Allen grub-screw fitted. It was inserted in the disc assembly and holes drilled through the latter for 2-B.A. bolts, using the bush itself as its own jig. Bolts were fitted through flange and washer and tightened up hard.

The next job was the most fiddling of all, fitting reinforcement to the outsides of the discs. These were made, each in six pieces and were in the form of segments of an annulus, being so cut that the axis of each was at right-angles to the run of the grain in the two outer plies. They were cut out on a jig-saw.

One of each was marked with three holes and drilled, and used as a template for drilling all the rest. The holes were countersunk.

The ends were carefully finished to the correct angle. The segments were now screwed on to their respective discs, again with a coat of varnish between.

The last segment in each ring was fitted to place by trimming its ends until it just came flush with the rest inside and out.

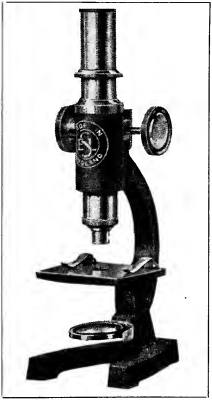
The whole was left overnight for the varnish to set.

(Continued on next page)

New Electrical and Optical Products

IN a new illustrated catalogue issued by Signalling Equipment Ltd., Merit House, Potters Bar, Middlesex, a very wide range of products, all of great interest to model engineers, is described. It includes small electric motors, both for low-voltage and mains supply, and transformers of various types and output for use with the former, also electrical outfits and components for experimenters.

The optical instruments shown are of special interest, and include telescopes, binoculars, and students' microscopes in three ranges of magnification, namely 44, 70, and 100 diameters. An example of the latter, illustrated herewith, has been submitted for our inspection, and after carefully testing it out on a variety of botanical, biological and mineral specimens, we can recommend it as a serviceable instrument which fills the gap between the cheap microscopes and the very expensive standard types.



Other interesting items in this well-produced catalogue include a range of model stationary steam engines and various mechanical models suitable for driving from small engines or motors, Morse keys and buzzers, and high-class boxed games, in which extensive use is made of brightly coloured plastic components. Examination of the actual components has convinced us that they are not in any way flattered or misrepresented in the catalogue illustrations.

Messrs. Signalling Equipment Ltd. have recently opened an entirely new factory overlooking the L.N.E.R. main line at Potter's Bar. It is in many respects a model factory, having a floor space of 20,000 sq. ft., with provision for expansion to several times its present size as circumstances permit, and is equipped with the most modern machine tools and production plant for dealing with the very wide range of products now in course of development.

A Stepped Pulley for a Whittle Belt

(Continued from previous page)

Next day, the unit was mounted on an expanding mandrel, small disc to the right and this was faced and turned on its rim, the unit was reversed and the big disc faced and turned likewise.

A square bar was mounted in the toolpost to act as a hand-toolrest and the two grooves were machined out with hand tools working to a 28 deg. angle.

This, by the way, is most important, if a Whittle belt (or any other " Vee " belt for that matter) is to function efficiently and wear well, the grooves in which it works must be of accurate contour and there must be ample bottom clearance.

The resulting pulley was perfectly satisfactory and has now been in use for some time ; incidentally, the belt is run very slack indeed ; that is another advantage of the Whittle belt ; having a much narrower angle than is usual, 28 deg. against 45 deg., it has a much more powerful wedging action and does not rely on tension to any degree at all, unless, of course, used in a vertical position, when tension must be sufficient to keep it in contact with the pulley. It has, too, other important advantages over the ordinary " endless " rubber " Vee " belts, it is adjustable and it can be put round " closed " pulleys without dismantling the bearings.

Altogether, properly applied, I regard it as one of the finest forms of drive extant.

The photograph shows the finished pulley and, though essentially so simple, it has well over 100 bits and pieces in its make-up !

Incidentally, the whole job had three coats of clear varnish when finished.

The time taken from start to finish was 11 hours.

Editor's Correspondence

Diaphragm Control for Model Steam Engines

Dear Sir,—I have just been carrying out some preliminary running tests on a little horizontal engine I have almost completed. These tests have been made with compressed air, and as I wanted to let the engine run for several hours at a time unattended, and as it was running in a room which was open to all and sundry, I wanted to make sure that it could not be raced by somebody opening the stop-valve.

I therefore made a little shim-brass diaphragm to go in the air line, and put a No. 60 drill hole in it (0.040 in. diameter). The engine has a cylinder 1 3/32 in. bore, 1 in. stroke, and air is available at a pressure of 80 lb. per sq. in.

Readers may be surprised to learn that, at this pressure, the diaphragm failed completely in its purpose; the engine, if ungoverned, running up to well over 2,000 r.p.m. A second diaphragm was substituted having a No. 70 hole (0.028 in. diameter), and this, too, though effecting some reduction in maximum speed, allowed the engine to run up to something of the order of 1,500 r.p.m. Next, a diaphragm with a No. 80 hole (0.0135 in. diameter) was tried, but this allowed insufficient air to run the engine at first. A No. 76 hole (0.020 in diameter) was somewhat on the big side still, but the engine would not run over 600 r.p.m. with it, so it was left in for several hours running.

After this, the No. 80 diaphragm was tried again, and the engine ran very happily with it at around 200 r.p.m. with the full 80 lb. pressure behind the diaphragm.

I am not putting forward these facts as " proving " that pinhole ports have any justification (and in the 50 odd years of its publication, I have never yet seen in this journal any attempt either to advocate or justify them, except in one solitary instance where they were used deliberately to keep down the piston speed); for I am fully cognisant of the desirability of providing ample-sized ports and, equally important, passages, in model steam engines intended to do serious work. I put them forward as interesting facts and as evidence of the extremely attenuated apertures through which it is possible to get quite a lot of compressed air.

This fitting of diaphragms is a thing which can be recommended to anybody loaning engines, other than locomotives, to exhibitions to be run under compressed air. In spite of all the stewarding in the world and all the notices, " Please do not touch," the modern uninhibited child *will* interfere with controls, sometimes with disastrous results.

Incidentally, this sort of thing is not confined to children, for one finds lots of adults (who, presumably, can read), completely disregarding notices of the type referred to, on the principle, apparently, that such notices could not possibly be intended for *them*.

This is a very real problem, common to all exhibitions, and most individuals and societies who exhibit, or loan for exhibition, with any regularity, have had bitter experience of the way models are damaged by anything from ineptitude to downright disregard of other people's property. Sweaty fingers do *not* improve polished steel work, and judging by long and bitter experience, about 90 per cent. of the sweaty fingers in England concentrate at model engineering exhibitions! The only real cure seems quite definitely to be the glass case; all the rest are merely slight abatements of a nuisance which arises through nothing more or less than selfishness and a disregard for other people's feelings.

Yours faithfully,

Harrow. K. N. Harris.

Traction Engines—An Appeal

Dear Sir,—As you are aware, for some months now I have been collecting data and information with the idea of writing a series of articles for The Model Engineer. These articles will deal primarily with traction engines, road locomotives and portable engines; but stationary engines of various types will also be illustrated and described. I can already promise to provide much information and a wealth of illustration of many types and makes, and to include sufficient dimensions of several types to enable would-be modellers to carry on.

I have already obtained a good deal of material, but it occurs to me that some readers must be in a position to help me to acquire more, by letting me have matter or data in their possession. This could be either on loan, or " given for the good of the cause," or I would be prepared to pay a reasonable price for same.

Suitable material includes photographs, engravings, coloured plates, and especially old catalogues and spare parts catalogues. Blueprints and dimensioned drawings would be of the highest value, as giving valuable sizes not obtainable from pictures or even often from catalogues.

Very useful, too, would be old books on the subject, such as W. Fletcher's *History and Development of Steam Locomotion on Common Roads* and *Steam Carriages and Traction Engines*; Wansborough's *Portable Engines*; L. M. Meyrick Jones' *Steam Road Vehicles*, and so forth.

In hoping for a good response to this appeal, I am emboldened by the fact that in a small way these articles will be of historical value, helping to perpetuate the existence of grand machines so rapidly disappearing.

Yours faithfully,

Sheffield. W. J. Hughes.